SCIENCE

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LOCUSTS IN ALGERIA.

In his last report on Algerian agriculture, Sir Lambert Playfair remarks on the spread of locusts from the eastern part of the province, to which they had hitherto for the most part confined their ravages, to the central regions. Until the eminent entomologist D'Herculais studied the matter carefully, no specific distinction among the locusts was recognized. He has now shown, according to the London *Times*, that there are two distinct species, belonging to separate genera, each of which has very marked peculiarities. These are the best known of the Biblical species, *Acridium peregrinum*, and the *Strauronotus maroccanus*. Their habits are quite different, the former generally arriving suddenly about April or May, in immense flights, and devastating the green crops. The females penetrate deeply into the moist earth, and deposit their eggs, from eighty to ninety in number, inclosed in a cocoon. Two months afterwards the young locusts or crickets are hatched. They grow rapidly, get their wings in forty-five days, and then continue their career of devastation far in advance.

The other species appear in a winged state in July and August. They also ravage what green exists at that season, and the females deposit their eggs at a much less depth than the others, generally on rocky ground. The cocoons do not contain more than thirty or forty eggs, and they remain without being hatched till the spring of the following year. The first species finds in central Africa the most favorable circumstances for its development; the second, in more temperate countries, such as the Mediterranean region, and even the Caucasus, Crimea, and Asia Minor. It is the latter that has ravaged Algeria during the last few years, but about the middle of December last the arrival of flights of the *Acridium* was reported from several of the oases of the extreme south. Fortunately man is not the only enemy of the locust. Starlings and larks feed eagerly on the eggs. Wagon-loads of these birds used constantly to be sent to the French market, but now the killing of them has been prohibited in the province of Constantine. The larvæ of the *Bombyx cantharis* and other insects also get into the cocoons, and often kill from ten to fifty per cent of the eggs, while minute cryptogamic organisms destroy many more.

The best method of contending against the locust has been very carefully studied. Much has been accomplished by ploughing the ground deeply as soon as possible after the eggs have been laid, so as to bring them to the surface, and thus allow them to become an easy prey to birds and insects. The collection and destruction of the cocoons by manual labor is less sure and more costly, but it has the advantage of affording employment to Arabs, who have been reduced to great misery by the destruction of their crops. The statistics of locusts thus destroyed is startling. It has been calculated that between August and December, 1888, the enormous quantity of 8,000 cubic metres of cocoons were collected and destroyed, and that these contained 200,000,000,000 eggs. After the insects were hatched, 1,200,000,000,000 crickets were killed, and it was the excess beyond these figures that invaded the land.

It is now admitted that the most efficacious means of waging war on the locusts is to concentrate all available resources on the destruction of the young. They remain quite stationary during five or six days after being hatched, and thus time is allowed for their destruction. The Arabs employ very primitive means: they jump among them, treading and crushing them under foot, beating about in every direction with branches of broom and oleander, and lighting immense fires all over the place, with alfa grass, or any dry brushwood that may be available. The most practical method is the use of screens similar to those employed in Cyprus. These are bands of cotton stuff, twenty to twenty-five metres in length, on which are sewn strips of American wax-cloth. The young crickets climb up the former, but when they arrive at the latter they can find no foothold, and tumble back into ditches prepared for their reception, along which sheets of zinc are placed to prevent their egress. As soon as the ditches are filled, the insects are covered over with earth and the screens advanced. During last season the material provided in Algeria, but which was altogether insufficient, was 6,000 screens, each 50 metres long; 100,000 oak pickets; 6,000 steel hammers; 450,000 metres of cord; and 60,000 sheets of zinc.

STEAM-JACKET EFFICIENCY.

In a paper on "Maximum Steam-Jacket Efficiency," contributed to the Journal of the Franklin Institute, Professor Robert H. Thurston says the fact is sufficiently well known that the steam-jacket, as employed on the steam engine, of whatever form and arrangement, is intrinsically a wasteful element, and that its use only gives, in certain cases, an economical advantage by its repression of wastes of larger magnitude. It checks a serious unavoidable waste, more or less completely, by a process which as inevitably involves a waste which is commonly, but, perhaps, not invariably, a lesser one. The ideal steam engine, such as is treated of in the purely thermodynamic study of the steam engine, has a lower efficiency with, than it has without, a jacket. This is readily seen from illustrations computed and checked by Messrs. Hitchcock and Mount, at the suggestion of Professor Thurston, and published in his paper; and it is sufficiently evident, *à priori*, from the consideration that the unjacketed engine receives all its steam at a maximum temperature, expands it adiabatically to a certain terminal temperature, and then exhausts it; while the jacketed receives a part of its heat at intermediate temperatures, expands the fluid non-adiabatically, and finally rejects it at the terminal temperature, with a lower mean range of expansion. In other words, the jacketed engine departs furthest from the principles of economical operations first enunciated by Carnot: "All heat should be received at maximum temperature; expansion should be perfectly adiabatic, and should continue to the minimum temperature and pressure, and all should be rejected as nearly as possible at that minimum." Thus, "theoretically," if the use of that much-abused term may be permitted in this sense, the unjacketed engine is more efficient than the jacketed engine. "Practically," however, the reverse is usually, though probably not always, the case, and the use of the jacket is often found to be productive of a real, and sometimes of large, economy. It is thus obvious that the advantages of the employment of the jacket come of those conditions which distinguish so markedly the real from the ideal case in steam-engine economy; those which make the "theory of the real engine," as the writer has called it, essentially different, in important respects, from the "theory of the ideal engine." In 1886 a "research committee" was appointed by the British Institution of Mechanical Engineers, to investigate the subject of the steam jacket. A very unusually complete set of data, pertaining to trials made with a view to determine the efficiency produced by application of the jacket, was secured. From computations based on these data, performed with great care, the computers checking the figures and the results, there can be no doubt of the existence of a maximum in the value of the steam jacket, the ratios of expansion being varied, and it is probably fairly to be assumed that it may be found in all cases. In the first case, that of the simple non-condensing Corliss engine, the heads unjacketed, the use of the jacket reduced the cylinder wastes from about twenty-five per cent of the ideal consumption of steam and

feed-water to about half that proportion, for ratios of expansion approximating six; from one-third to about one-tenth, at a ratio of five; and apparently from twenty to ten per cent at 4.4. In this first case, also, the jacket gives best results, with 110 pounds of steam, when the ration of expansion approximates six. When the steam pressure falls to approximately eighty pounds, the best work of the jacket occurs at a ratio not far from 4.75; while, at a pressure of fifty pounds, the value of the jacket increases through the whole range of the experiments, and not only so, but the indications are of probable improvement indefinitely in the direction of increasing expansion. The highest efficiencies, however, either with or without the jacket, are found, in this case, at the lowest ratios adopted, and indicate a maximum value at about 3 25. The ratios of expansion for maximum efficiency of fluid, in the other cases, are for 110 pounds, about five, and for eighty pounds, about 3 5. Similarly studying the performance of the condensing engine, we find that the best work is done, whether jacketed or not, at about a ratio of expansion of ten (at a steam pressure of 110 pounds), but that the jacketed engine reduces the internal wastes from fifty per cent at highest ratios, and from one-fourth at the lowest ratios, in the case of the unjacketed engine, to five per cent, and, in some cases, probably to within the magnitude of the errors of observation. At a pressure of ninety pounds the best ratio seems to be for this engine, under the given conditions of operation, about 6.5 when unjacketed, and 8.5 jacketed; while the lower pressures still further reduce both the efficiencies and the savings effected by the jacket. The best work of the jacket, as an economizer of heat, is done at high pressure, at a ratio of expansion of twelve or more. In all cases it seems to be the fact, with these engines at least, that the jacket is useful beyond the ratios of maximum efficiency of fluid. The compound engine exhibits the same general effects which have been noted in the cases of simple engines. This discovery of a maximum efficiency of jacket may throw some light upon the causes of the conflicting and sometimes apparently irreconcilable results of trials of engines with and without jackets, and with jackets variously constructed. The discovery may also prove of value to the designer, as aiding him in securing the best proportions and arrangement of his engine.

THE PREVAILING FEVERS OF CHINA.

DR. COLTMAN, writing in the *Medical Missionary Journal* upon the fevers of China, remarks, says the *Lancet*, that but little personal investigation on the subject has been made up to the present time, owing to the comparatively recent advent of foreign medical men, and to the want of confidence on the part of natives to submit for any lengthened period to the treatment of a foreign physician, or, in fact, to any one physician, their rule being to change doctors two or three times a day if they can afford it. Again, there have been but small hospital facilities for studying fevers, and there is an impossibility of obtaining post-mortem examinations. Dr. Coltman considers that small-pox is the most common disease, nearly every person suffering from it at some period of his or her life. Vaccination, although practiced, is done very carelessly. Measles appear to be common, but are somewhat milder than in Europe. Scarlet-fever, although it undoubtedly occurs among the natives, is far less common than among Europeans. Erysipelas is rare. Typhoid-fever is very difficult to diagnose in the short time that a foreign medical man is allowed to attend a case; but Dr. Coltman thinks that when more accurate reports are possible, this disease will be found to be more common among the natives than is now supposed. Typhus-fever is met with all over North China, and as far south as Shanghai. Relapsing fever is found constantly associated with typhus. Dengue does not seem to be known among natives. Cholera occurs as an epidemic every few years, and is very fatal. Diphtheria is severe, and frequently fatal among the natives. Whooping-cough has occasionally been met with. Rheumatic fever is very prevalent in some parts. Chronic muscular rheumatism is common all over China, but is unattended by fever. Malarial fevers appear to be common everywhere, though the prevailing type varies; thus, tertian is most common in Pekin, quartan in Foochow, Swatow, Shanghai, and Hangchow, and remittent in Cheefoo and Tientsin. In Chinanfu, Dr. Coltman has never seen a case of quartan ague; it is all intermittent of the tertian or quotidian type. The treatment, of course, of all malarial fever is by quinine or some other cinchona bark alkaloid. In Hangchow the carbolic acid and iodine treatment has been used successfully as a prophylactic; arsenic is recognized as valuable in the chronic form.

NOTES AND NEWS.

THE trustees of the University of Pennsylvania have elected Dr. George A. Peirsol, professor of anatomy; Dr. Harrison Allen, professor of comparative anatomy; and Dr. John B. Deaver, assistant professor of applied anatomy.

— Mr. Emil Theilman, a graduate of the Missouri State University, has been appointed to a position as aide on the State Geological Survey.

— Professor Henry S. Munroe is to have charge of the Columbia College School of Mines' summer school of surveying at Litchfield, Conn.

— Professor J. F. Kemp of Cornell University, Ithaca, N.Y., has been appointed adjunct professor of geology at Columbia College, New York.

— The *Engineering and Mining Journal* of this city states that extensive deposits of onyx have been discovered near Marion, Smyth County, Va. Four openings are reported to have been made so far. The stone is said to be of excellent quality.

— The Marine Laboratory of the Johns Hopkins University will be open this summer at Port Antonio on the north-east coast of Jamaica. Professor Brooks and a number of members of his party have already started for the station.

— A writer in *Science Gossip* says that the philosopher Kant one day was passing a certain building in his daily walk, and on looking up, he discovered, as he fancied, that the old birds were actually throwing their young ones out of the nests. It was a season remarkable for the scarcity of insects, and the birds were apparently sacrificing some of their progeny to save the rest.

— The harbor of Salonica, says the *Scottish Geographical Magazine*, is threatened with the same fate as that which has befallen Smyrna. Owing to the alluvial deposits of the Vardar, the harbor is becoming useless as a trading port. The entrance through the sandbanks is very difficult, and the delta of the river has advanced to the neighborhood of Cape Kara-Burun. The prospective value of Salonica to Austria-Hungary may therefore be questioned.

— The recent census of Bengal, says the London *Times* correspondent, in a dispatch of March 27, throws an instructive light on the sanitary condition of the province. The districts showing a decrease in population are mainly those where defective subsoil drainage produces malaria. This is especially marked in parts of Nadiya and Jessor, and is due to the fact that the natural drainage channels have been blocked by injudicious cultivation, and the want of sufficient provision for a water-way in the construction of the railway.

— We learn from the *Scottish Geographical Magazine* that Dr. Konrad Ganzenmüller has published in the *Zeitschrift für wissenschaftliche Geographie* (Bd. viii., Heft 1) a learned and able paper illustrating his hypothesis that the Ukerewe, or Victoria Nyanza, is identical with the Eastern Nile sources of Ptolemy, with the Crocodile Lake of an unknown Greek writer, and with "Kura Kavar" of the Arabs, and that fairly accurate knowledge of the territory of the Nile sources was formerly possessed, but subsequently was lost.

— The collections of fishes made by the "Albatross" in 1887-88, at the Galapagos Islands and in Panama Bay, were reported on by Jordan and Bollmann in the "Proceedings of the United States National Museum," 1889, pp. 149-183. A small portion of the collection, however, failed to reach the authors in time for their report, and has now been listed by Charles H. Gilbert, professor of geology in the University of Indiana. The supplementary list is noteworthy as containing the remarkable new genus *Dialommus* which repeats in the *Blenniidæ* the peculiar structure of the eye seen in the Cyprinodont genus *Anableps*.

— European invalids and other persons in search of quiet and a mild climate for winter are beginning to turn their attention to the oases on the northern border of the great Sahara. The climate is said to be very equable. Railway communication through Algeria makes these places less inaccessible than formerly.

— Dr. A. C. Abbott, assistant in bacteriology at the Johns Hopkins Hospital, has resigned his position, to accept the place of assistant director of the Hygienic Institute in Philadelphia. Dr. G. H. F. Nuttall has been elected to fill the vacancy.

— According to the Boston *Medical and Surgical Journal*, Eternod and Haxiers, from the results of their experiments on the transferrence of small-pox from man to the calf, are convinced that small-pox and cow-pox are caused by the same virus. For the purpose of inoculation, small-pox lymph from cases varying in severity was used, and was rubbed into a moderately large extent of scarified skin in the abdominal region of the calf. The first inoculation was followed in every case by a scanty crop of postules at the spot chosen. This eruption had at first very little resemblance to typical cow-pox, but on transferring the disease from calf to calf it became more and more characteristic, until, in the opinion of the authors, it was impossible to distinguish it from true cow-pox. The calves vaccinated in this way with human small pox lymph were found in every case to be refractory to vaccination with ordinary cow-pox lymph.

— In early times Asia Minor was celebrated for its fine breeds of sheep and the high quality of its wool, but for many centuries the fat-tailed variety of sheep has replaced all the finer breeds. United States consul Jewett, in a recent report, says that the well-known characteristic of this breed is the enormous tail, which is one mass of fat. These tails will sometimes weigh as much as eighteen pounds each, and give some weight of credibility to Herodotus's story that in Cilicia the sheep had little carts attached to them, that they might the more easily carry their tails. Some shepherds practise cutting off a part of the tails of lambs, severing them at the third or fourth vertebra. This is done in the belief that a large part of a sheep's nourishment goes to the benefit of the tail. It is said, as an evidence of this, that it has been noticed that during times of drought, when pasturage is scant, the sheep's body in general does not comparatively show the effects of lack of food, but that the tail becomes smaller and thinner.

— A large model in relief of Baltimore and its vicinity has been made by Mr. Cosmos Mindeleff of the United States Bureau of Ethnology, for Mr. H. C. Turnbull of Baltimore. Mr. Turnbull has placed the model in the Baltimore Real Estate Exchange. The area embraced extends seventeen and a half miles from north to south, thirteen and a half from east to west, with the city at its centre. This is two hundred and thirty six square miles, including Green Spring Valley on the north, reaching nearly to Sparrows' Point on the east, extending three and a half miles south of the Relay, and considerably west of Catonsville and Pikesville. The scale of the model is four inches to the mile, making its dimensions four feet eight inches by five feet six inches. Its most noticeable feature is the fact that its vertical scale is the same as its horizontal; i.e., all elevations are represented in relief on a scale of four inches to 5,280 feet or one mile. Since the highest point within the area is only 560 feet above tide, all the relief is modeled within less than half an inch.

— The second number for 1891 of the bulletin of the Ohio Agricultural Experiment Station describes three insects which are doing considerable damage to clover and clover hay. The first of these is the clover-root borer. The adult of this insect is a small, brownish black, minutely-spotted beetle, not quite one tenth of an inch long, which deposits its eggs during spring in the crown of the clover plant, four or five eggs being laid on each plant. These hatch, and the larvæ burrow downward through the larger roots of the plant, feeding upon the inner substance, and filling the galleries behind them with their sawdust-like excrement. Late in summer the larvæ become fully grown, when they are one-eighth of an inch long, with a whitish body and yellow head. The injuries of this insect are sometimes very serious, whole fields of clover being destroyed. The remedy is frequent rotation of crops, thus not allowing the clover fields to stand until they become breeding places for the insects. The second insect is the clover-seed midge, a small, orange-colored maggot that develops in the clover-heads at the expense of the seed. It hatches from eggs laid by a very small, two-winged fly, similar to the Hessian fly in appearance. Clover fields infested by this insect are at once distinguished by the unnatural condition of the heads at the time of blossoming. Instead of being red with bloom the heads are green and dwarfed on account of the undeveloped florets. The best preventive of the injuries of this insect yet suggested is that of mowing the field as soon as the presence of the insect is detected, and before any of the seed has reached maturity. The third of these insects is the clover hay worm. Clover hay that has been standing in the mow or stack for some time is liable to become infested by small brown worms, which web the dried stems and leaves together and feed upon them. In one case, to which the attention of the station was called this spring, the lower half of a stack of clover hay was almost totally destroyed by this worm. These worms are more likely to prove troublesome when old hay is left over from season to season for them to breed in; consequently hay-mows should be thoroughly cleaned out each summer, and new stacks should not be put on old foundations until all the leavings of the previous season are removed. Hay which is infested with the worms should be burned.

— Dr. G. H. Williams left Baltimore on May 25, with a party of graduate students of the geological department of the Johns Hopkins University, on a scientific trip in western Maryland. The purpose of the trip is to supplement the work of the recent expedition in southern Maryland. Special attention will be paid to the geological formation of the region.

— The Workingman's School, on West Fifty-fourth Street, New York, was founded in 1878. It was started as a free kindergarten for the children of the poorer classes in the tenement house district. The number of pupils during the first weeks after the opening of the kindergarten was thirty-three. The school has now between three and four hundred pupils, divided into five grammar, three primary, and three kindergarten classes; and it owns a substantial five-story building, containing more than twenty large rooms, a lecture hall, machine shop, etc. Besides the ordinary branches, its course of study embraces manual and art work, a complete course in elementary natural science, gymnastics, music, etc., and a kindergarten normal department has been added to the school proper. The normal kindergarten class will re-open Sept. 14, 1891, and continue till the end of the following June. Applicants for admission must be at least eighteen years of age. The general requisites are, a good English education (high or normal school or their equivalent), ability to sing, and a real interest in and love for little children. The course includes psychology and a study of child-nature, history of education, the principles and methods of Froebel's system, together with practice in the use of the gifts and occupations. Practical work with the children, under the direction of experienced kindergarteners, occupies the mornings; and several afternoons a week are devoted to the theoretical studies. The tuition fee, including all materials, is $65 for the entire course, payable semi-annually. No entrance examination is required, but each student is received on trial for a few weeks, in order that her general fitness for the work may be determined. Regular examinations are held at the end of the course, and certificates given to those who complete it satisfactorily. Further information may be obtained from Miss C. T. Haven, principal of the kindergarten, and, after June 1, from the superintendent of the school, Mr. Maximilian Groszmann, 109 West Fifty-fourth Street, New York.

"A Description of Materials used in Making Commercial Fertilizers," "Fertilizing Materials produced on Farms," and "Fertilizing Composition and Valuation of Various Products," are the titles of articles contained in Bulletin 32 (new series) of the New York Agricultural Experiment Station, of which Peter Collier is director. These fertilizer bulletins are intended to explain such facts as will make farmers familiar with the different terms used to express the composition of fertilizers, and also to enable them to understand some of the more general principles involved in the use of fertilizers, together with such other infor-

mation as it is thought farmers would like to possess. In order that an attempt may be made to cover all points about which information is desired, farmers are urged to send to the station any inquiries in this line in regard to which they desire specific information. This series of bulletins is issued for the benefit of the farmers of New York State. As each bulletin will be a continuation of the preceding one, it will be well for those interested to preserve the early issues for future reference. These and all other bulletins issued by the station will be mailed to any citizen of the State, on application.

— The London correspondent of the New York *Times* writes that the principal biologists and scientists of England, headed by Lubbock, Lister, Lockyer, Playfair, Roscoe and others, to the number of a hunded and fifty, and backed by strong letters from Huxley and Tyndall, recently waited on Sir Michael Hicks-Beach, president of the Board of Works, for a second time, to beg that a license be found for the British Institute of Preventive Medicine, and for a second time met with a refusal. Their eloquent speeches laid stress upon the national disgrace of a situation in which English students of bacterial growths were compelled to go to Paris, Berlin, and Vienna to study their science, and intelligent inquiry and experimental research were forbidden on English soil, as if it were an impious thing to seek for wisdom in the science of saving human life. Sir Michael Hicks-Beach gave an evasive and roundabout reply, which the London *Times* editorially translates as meaning that the anti-vivisectionists have many times more votes in England than all its men of science put together. English laws pay great attention to conserving the rights of rich men to breed hares, rabbits, and game-birds for annual slaughter and maiming by shooting parties, but they sternly punish a man of science who chloroforms one of these rabbits for purposes of experiments having no earthly purpose but to increase knowledge as to saving human life.

— "The last thing that it would be proper for me to do," said Professor Huxley recently, in writing of himself and his aims, "would be to speak of the work of my life, or to say at the end of the day whether I think I have earned my wages or not. Men are said to be partial judges of themselves — young men may be, I doubt if old men are. Life seems terribly foreshortened as they look back, and the mountain they set themselves to climb in youth turns out to be a mere spur of immeasurably higher ranges when, with failing breath, they reach the top. But if I may speak of the objects I have had more or less definitely in view since I began the ascent of my hillock, they are briefly these: To promote the increase of natural knowledge, and to forward the application of scientific methods of investigation to all the problems of life to the best of my ability, in the conviction, which has grown with my growth and strengthened with my strength, that there is no alleviation for the sufferings of mankind except veracity of thought and of action, and the resolute facing of the world as it is when the garment of make-believe by which pious hands have hidden its uglier features is stripped off. It is with this intent that I have subordinated any reasonable, or unreasonable, ambition for scientific fame which I may have permitted myself to entertain, to other ends, — to the popularization of science; to the development and organization of scientific education; to the endless series of battles and skirmishes over evolution; and to untiring opposition to that ecclesiastical spirit, that clericalism, which in England, as everywhere else, and to whatever denomination it may belong, is the deadly enemy of science."

— An interesting discovery has just been made at Rome in the process of excavation for the Tiber embankment. An oblong column, or very thick slab, was uncovered, on which is inscribed the official record of the public games celebrated by Augustus in the year 17 B.C. The decree of the Senate and the regulations enforced by the executive committee are followed by a list of the necessary prayers and sacrifices and the order of the contests. Then comes an announcement that a choir of twenty-seven youths and as many maidens will sing the Carmen Seculare, written by Quintus Horatius Flaccus. In the same locality the workmen have discovered twenty-five additional fragments of the great map of the old city which formerly stood in the Forum of Augustus. When this map was destroyed by fire or earthquake, many of the pieces were thrown into a heap of broken building materials, and finally found their way into the walls of the old Alfieri palace which have just been unearthed.

— The *Kölnische Zeitung* reports that the investigations which the expedition sent out by the Vienna Academy of Sciences has been carrying out in the eastern portion of the Mediterranean have been very successful, and have given important results. In all, the investigations concerning the depth and general characteristics of the sea, and the presence of life in it, were carried out at seventy-two distinct points. The greatest depth (3,700 metres) was found near the great depression which runs between Mola and Cerigo, — a deep valley running in a north and south direction, and with a depth varying from 3,500 to 4,000 metres, the descent being much more abrupt on the Greek side than on the Italian and Sicilian side. Experiments as to light showed that the waters are more transparent near the African coast than in the northern portions. There, white metal plates were discernible at a depth of nearly 144 feet. Sensitive plates were still found capable of being acted upon by light at a depth of nearly 550 yards, at a point 200 nautical miles north of Benghazi: on being drawn up they were found to have been blackened. The acid constituents of the sea-water seem to be the same at the greatest depth as near the surface, nor is any difference in the quantity of ammoniacal constituents perceptible between the upper and the lowest levels, with the exception that everywhere close to the bottom the quantity of ammonia is notable. The deep sea region of the eastern Mediterranean is very poor in animal life. A dredge at a depth of 3,000 metres brought up no animal specimens at all; but at a depth of 2,000 metres leaf-formed algæ were discovered similar to those found at the same depth in the Atlantic by the Plankton expedition.

— The climatic conditions in Corea are imperfectly known; but the *Annalen der Hydrographie* (i., 1891) publishes some valuable meteorological observations (*Scottish Geog. Mag.*, June, 1891) that were made at the Corean ports of Chimulpo, Juensan, and Fusan. The two latter lie on the east coast of Corea, and the former is on the west coast. The chief features of the Corean climate — if one may judge from observations extending over only three years — appear to be the following: Atmospheric pressure at the three stations, mentioned above, is comparatively high from November to February (winter), and low from May to September (summer). Whilst the west coast is somewhat cooler than the east coast, the temperature of the air is rapidly lowered from south to north. The mean annual temperature is much the same as that of places in the same latitude on the east coast of North America. The summer temperatures at the three stations are much the same; but the winters at Chimulpo and Juensan are much colder than at Fusan. At Chimulpo the mercury fell below the freezing-point during the months of October to April; in Juensan, from October to March; in Fusan, from December to May. The mean temperature of the warmest months (July or August) was 26.2° C. in Chimulpo, 26.8° C. in Fusan and Juensan; and of the coldest months (January or February) 5° C. in Fusan, — 4.4° in Chimulpo, and 5.1° C. in Juensan. The prevailing wings are of a monsoon character: on the east coast, easterly; on the west coast, south-westerly. The rainfall decreases from south to north, and is heavier on the east than on the west coast. The rainy season is in summer, the dry season in winter. In Juensan the rainfall was *nil* in January and February of the three observed years. There was no snowfall in Fusan.

— According to the London *Educational Times*, Professor Jean Servais Stas, who recently completed the fiftieth year of membership of the Royal Belgian Academy of Sciences, Literature, and Arts, has been congratulated on that event by the Chemical Society of London in an address which refers to the researches that have placed the name of Stas so high amongst scientific investigators. Among the fundamentally important investigations which have helped to raise chemistry to the dignity of an exact science, are mentioned his "incomparable determinations of the atomic weights of a large number of the more important elements." Not only do the results supply numerical data of the

utmost value, but the "researches are models which must ever serve to show how such determinations should be effected, and the innumerable precautions which must be taken" His refutation of the celebrated hypothesis of Prout, at least in its original form, is noted; as also the services rendered to the chemist by his teaching how to prepare pure re-agents, — the methods devised for the purpose being themselves, in many cases, important contributions to chemical science. The address concludes thus: "Your 'Recherches sur les Rapports reciproques des Poids atomiques' must be handed down to future generations as one of the most valuable classics of the exact sciences. Apart from the intrinsic value of your work, you have, through it, exercised a beneficent influence on your colleagues throughout the world, the importance of which cannot be over estimated, and in the eyes of chemists generally you are ever regarded as an honor to science, to your country, and to the distinguished academy of which you have been an ornament for half a century."

— The monthly report of State Geologist Arthur Winslow of Missouri is at hand. From it we learn that during the month of May examinations of clays and structural materials have been continued in Franklin, Warren, and St. Charles Counties: and the mineral springs of Barry, McDonald, Vernon, Cedar, Henry, Benton, and Camden Counties have been visited, and samples of their waters have been collected for analysis. The examinations of clays and structural materials have further been extended into Ralls, Pike, and Marion Counties. Detailed mapping has been prosecuted in the south-east in Madison County, and west in Ray and Johnson Counties, and about a hundred and ninety square miles have been covered. Examination of coal deposits have been made in Marion County, and samples of coals have been collected for test. In the laboratory, analyses have been made of coals and mineral waters, and the experimental work on clays has continued. Much material has been collected for the report on the pal eontology of the State, and, in this connection, public and private collections in St. Louis, Hannibal, Sedalia, Columbia, Kansas City, and Tabor were visited and studied.

— Lieut. Reed of the United States Artillery stated in a recent paper that photography has been largely used for surveying in Canada under the direction of Mr. E. Deville, the surveyor-general. The Dominion survey made in the ordinary way proved very expensive and slow when the Rocky Mountains were reached, and photography was accordingly resorted to The camera used, as described in *Engineering*, was a carefully made mahogany, brass bound, rectangular box, half-plate size. When in use it was placed on a tripod furnished with levelling screws, and levelled by means of two ordinary tube levels attached at right angles to each other, and which could be placed on that face of the camera which happened to be uppermost. The means for determining the horizon and principal lines were the images of four fine combs, one midway on each side, attached to the camera immediately in front of the plate, the use of small stops making these images clear. The lens used was a Dallmeyer wide angle, No. 1, A. of 5¾ inches focus, affording a horizontal angle of sixty degrees when the plate was disposed with its longer edge horizontal. Six double plate holders were employed. But one adjustment of this camera is required, namely, to insure the verticality of the plate when the tube-levels indicate that the camera is level. The best way to effect this is to substitute for the plate a good plane mirror, face to the rear; then set up a transit in the vicinity. The axis of the telescope being horizontal, observe a distant point intersected by the cross wires, also its image in the mirror: if the latter is also intersected, the mirror is vertical; if not then the tube levels need adjustment. This box camera being rigid, and the focus therefore permanent and suited to distant views and the lines on the faces indicating the field of view, no ground glass or cloth is needed. Care is taken to make the plate-holders exactly alike, a condition which, so far as distance from lens to plate is concerned, is ascertained by measurement Orthochromatic gelatine plates give the best results. Mr Deville considers that a survey made in this way is as accurate as a plan plotted with a very good protractor or made with a plane table. A good deal of attention has been devoted to the subject in France by Dr. Gustave le Bon, who has shown how to obtain all the survey details from a single photograph and one compass observation, provided any one distance contained in the photograph is known.

— The kryokonite collected by Nordenskjöld in Greenland in 1883 has been investigated by Wülfing, and, according to the *Engineering and Mining Journal*, has been found to consist mainly of feldspar, quartz, mica, and hornblende. Garnet, zircon, magnetite, augite, sillimanite, together with a nitrogenous organic substance, are also present in it. The larger part of the dust is thought to be a sediment from the air, and to have been obtained by it from a region of crystalline schists. But the most interesting constituents of the dust, little chrondri of opaque, isotropic, transparent, and double-refractive material, are considered to be of cosmic origin, owing to their similarity to the chrondri obtained in deep-sea soundings. If the amount of dust collected from the snow in Greenland represents the fall in one year, the total amount falling upon the entire surface of the earth in this time is 125.000,000 kilograms, equivalent to a cube of 31 yards on a side.

— Herr P. von Stenin has given a description in *Globus* (Bd. lviii. No. 12) of the Tcheremis, a synopsis of which appears in the *Scottish Geographical Magazine* for June. The details are taken from a monograph written by Professor Smirnoff, of Kazan University, who visited this people in the spring of 1888. The main body now dwells between the Volga and Viatka: they are also found on the Kama, the Bielaja, and its tributaries. Their country falls into two distinct divisions — the "mountain land," stretching from Vassilssursk on the west to Ilyinka on the east, and the "meadow land," much larger in extent, bounded on the west by the Vetluga and its tributaries, the Yuronga and the Usta, on the north by the Viatka, on the east by the Ilet, and on the south by the Volga and the lower Kama. The number of the Tcheremis is given by Smirnoff as 312,591. The mountain land is well clothed with woods of fir and pine, and possesses a very fertile soil; and its inhabitants, who are taller, more powerful, and handsomer than their lowland brethren, follow agricultural pursuits, while the meadow-land Tcheremis, seventy per cent of whose territory is covered with forest, maintain themselves chiefly by the chase. Little in the villages of the Tcheremis is of native origin. Their houses, clothing, dishes, etc., are copied from their Russian or Tartar neighbors. A hut of thin planks, roofed with shingles and used as a summer dwelling, is a peculiarity of the Tcheremis' farm-house, and the women's dress shows some marks of originality. Polygamy still prevails among the pagan Tcheremis. Professor Smirnoff believes that it was not introduced through Mohammedan influence, but is a modification of hetairism, under which system all the women of the tribe were common property. In some districts it is still the practice to carry off a wife by force, and in others the customs observed at the marriage indicate its former existence. The purchase of wives succeeded to rape, owing to Turkish influence, the price being at first regarded as an expiation, as is indicated by the name it bears. The Tcheremis believe in a life after death, and credit the dead with the power of returning to the world. Accordingly, they place food and drink in the coffins, and on certain festivals prepare feasts for their departed relatives. In a child's coffin they place a string, on which is measured the height of the father or mother, at the same time expressing a hope that the child will grow up to be an efficient workman; and they lay bridal garments in the coffin of a girl. From the ranks of the dead are recruited a vast host of evil spirits; e.g., various kinds of fever are caused by the spirits of spinsters. The gods of the Tcheremis are also very numerous. There are the God of Heaven, the God of the Dawn, the Ruler of the World, the Mother of the Bright Sun, and many others. All those deities which stand in close relation to men — such as the gods who give rain, guard the cattle, and protect the fruit and fish — are propitiated with sacrifices. At the present day, however, the Tcheremis offer part only of the victim, the head or heart, and in some districts substitute cakes made in the shape of a horse. The place of sacrifice is usually a grove, and is chosen by a supposed sign from the gods, such as the bursting forth of a new spring. Among the mountain Tcheremis the Greek Church has made considerable progress.

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THE STRUCTURE AND PHYSICAL PROPERTIES OF SOILS.[1]

THERE is no more important economic problem to-day than the production of food and textile fibre to support the life of a rapidly increasing population and to supply their rapidly increasing wants in this age of advancing civilization. Agriculture is the basis of all manufactures, trades, and commerce, and the soil is the basis of all agriculture. This was not generally recognized until Liebig's brilliant generalization of the mineral theory of plant growth, and there was in consequence no material advance in agricultural methods or practices until his time. Since then this mineral theory has been the subject of a vast amount of the most patient research, carried on in the field, laboratory, and plant house. At first it was only considered necessary to determine the chemical composition of a soil and the composition of a given crop to indicate whether the soil had all the elements of plant food in the relative amount contained in the plant, to show whether the soil was well adapted to the crop, or how it could be made so by the addition of chemical substances. Then it was found that all soils have sufficient plant food for ages to come, and that continued cropping during the lifetime of a man would not reduce this amount materially. Then it was claimed, and is still held by many, that only a very small part of the plant food in the soil is in a condition to be readily available to plants, and if this available food is not used up it quickly reverts to a rocky and insoluble form. Then it was endeavored, by the use of solvents of various strengths, to determine how much of this plant food is at any time available to plants; and failing in this, the work has been pushed blindly forward with plat experiments, trying all kinds of mixtures of all kinds of fertilizers, on all kinds of soils, indiscriminately, as one might go into a drug store in the dark and blindly try all the drugs to cure dyspepsia, for it is dyspepsia that affects the plant more often than any thing else,—an inability to appropriate and assimilate the food within reach. We are spending vast sums of money for commercial fertilizers, which are used indiscriminately on all classes of soil, whether they be light and sandy, or stiff with clay.

The physical character of the soil has been considered, in all or nearly all the investigations I have ever seen, a vague, complex, but, on the whole, a relatively unimportant factor. The soil is considered a unit. Soils differ physically, just as men differ physically. There is a type of soil suited to grass, another to wheat, others to the different grades of tobacco, and still others to trucks and vegetables. The whole appearance and aspect of the soils differ to the eye and touch.

It is a notorious fact that changing seasons of wet or dry, or hot or cold, have far more effect on the crops than any combination of manures. This in itself is a significant fact.

In ten years a soil may be so worn out as to become a barren waste. This is not from any loss of plant food, for the amount so removed from the soil is relatively so small that it cannot be detected with any certainty. But the fact confronts us, that the wheat and corn lands of the great North-west are deteriorating, and the wheat and tobacco lands of our own State are deteriorating, both as to quality and quantity of product.

I come now to the main point of this paper, that the exhaustion of soils is physical rather than chemical; that vegetation, under given climatic conditions, is dependent upon the circulation or movement of water in the soil, and that it is possible to change the physical conditions of the soil so as to control this water circulation, and so control the growth and development of the plant. Nay, further, that the chief benefit derived from the use of commercial fertilizers and manures is their physical effect on the soil, which modifies the relation of the soil to water, rather than, as heretofore supposed, to the actual amount of food they supply the plant. The soil is to be considered as a vast irrigating pump which provides standing room for the plant and supplies it constantly with nutritive fluids. If too much water is supplied the plant is inclined to develop leaf in large excess; if too little water is supplied the growth is stunted, but it puts on relatively more fruit. It is a mean between them that is desired for all plants, but a different mean for each class of plants.

The soil is composed of minute fragments of rocks and minerals, with varying quantities of organic matter. Even the poorest and most barren soils are shown by chemical analysis to have sufficient plant food for countless generations of plant life, while in ten years or less a soil may be "worn out," and made for a time a barren waste.

However compact and continuous and close textured a soil or sub-soil looks, there is still about fifty per cent by volume of empty space between the solid particles. That is, a cubic foot of soil will hold half a cubic foot of water, if all the space is filled. Clay soils have more empty space than sandy soils. We have found on the average about forty-five per cent by volume of empty space in sandy soils and fifty-five per cent in clay lands. The amount of empty space in the soil may readily be calculated by dividing the weight of soil by the specific gravity, which gives the actual volume of the soil grains, and subtracting this from the total volume occu-

[1] Abstract of a paper read by Professor Milton Whitney of the Maryland Agricultural Experiment Station before the University Scientific Association, March 25, 1891.

pied by the soil. The light sandy sands, therefore, are light only in texture, for a cubic foot of sand weighs about one hundred and ten pounds, while an equal volume of clay weighs seventy-five pounds.

The water of the soil has to move in this empty space, and the relative rate of movement will depend upon how many particles there are in the soil, for this will determine the number and size of the spaces between the particles in which the water will have to move.

The soil particles vary in size from about 2 millimetres in diameter to about .0001 of a millimetre, which is near the limit of microscopic vision. The coarser particles are called sand, while the very finest particles are known as "clay." We cannot emphasize this point too strongly, that clay differs from sand only in the size of the grains. The particles of clay are hard and compact as sand, are composed largely of quartz, and they have themselves none of the inherent stickiness associated with clay in mass.

The plasticity of moist clay and the hardness of dry clay in mass, as distinguished from the looseness and incoherency of sand, is due to the fact that the clay has a vastly greater number of particles in a unit mass than sand has, and as each grain touches the surface of six or eight adjacent grains, there are many more points of contact for surface attraction to act and bind the mass of clay together.

The approximate number and size of the particles may be found or calculated from the mechanical analysis of a soil. The mechanical analysis consists in separating the particles into eight or ten or more grades whose diameters range between rather narrow limits by sifting and subsidence in water.

The mechanical analysis in its simplest form, as devised by Nöbel and adopted some years ago by the Society of Agricultural Chemists of Germany, consists in boiling the soil for some time in water, to disintegrate any lumps, and placing it in the first of a series of conical-shaped vessels having a capacity respectively of 1, 8, 27, 64. A stream of water is let in which carries the finer particles over into the next succeeding larger vessel, where, the motion of the water being slower, grains of somewhat smaller size may settle, and so on. Many small grains are, however, carried down with the large ones, and Hilgard has improved on this by having a paddle revolving at a high speeed in a porcelain cup, which keeps the soil thoroughly agitated. From here the mixture rises into a wide tube sufficiently high so that large grains thrown up by the current of the paddle will not go over. When the water comes over clear the receiving vessel is changed, and the velocity of the water is increased so as to carry over grains of a larger size. Johnson and Osborn have simplified this in the following method. The soil is gently rubbed up in a mortar with a rubber pestle with repeated quantities of water, until the water, after standing a moment over the soil in the mortar, is perfectly clear and all grains smaller than .05 of a millimetre have been removed, as shown by microscopic measurements. The coarser grains are then sifted in a series of sieves.

The turbid liquid is allowed to stand until all particles, larger than a certain size, have settled, as shown by microscopic measurements on a drop of the liquid removed with a rod or tube. The turbid liquid is poured off into another beaker to settle, and the contents of the first beaker is stirred up with a fresh quantity of water, and the settling continued until all particles, smaller than a certain size, are removed, and so on for the several grades. The separations are finally dried and weighed.

The following table gives the mechanical analysis of two markedly different types of soil: —

Diameter in Millimetres.		Truck Soil.	Limestone Subsoil.	Approximate Number of particles in 1 gram.	
				Truck Soil.	Limestone Subsoil.
2 to 1	Fine Gravel.	1.41	0.00	3	0
1 " .5	Coarse Sand.	8.19	0.00	142	0
.5 " .25	Medium Sand.	43.78	0.18	6,094	26
.25 " .1	Fine Sand.	24.04	0.26	32,930	371
.1 " .05	Very fine Sand.	5.81	2.39	101,000	43,350
.05 " .01	Silt.	8.61	27.60	2,341,000	7,825,000
.01 " .005	Fine Silt.	1.98	10.74	34,430,000	195,000,000
.005 " 0	Clay.	4.48	53.02	1,952,000,000	24,450,000,000
		98.23	94.19	1,988,911,169	24,652,868,747

From the results of the mechanical analysis, the approximate number of particles in the soil can be calculated from this formula: —

$$\frac{a}{\frac{\pi (d)^3 2.65}{6}} \div \text{total weight of soil.}$$

Where a is the weight of each group of particles, d the mean diameter of the particle in the groups, and 2.65 taken as the specific gravity of the soil.

From this and the weight of a unit volume of soil, the number of particles on a unit area of surface can be calculated.

$$\left(\sqrt{\text{No. particles in 1 cc.}}\right)^{\frac{2}{3}}$$

There will evidently be one space or opening into the soil for every surface grain. If the grains have a symmetrical arrangement the mean size of these spaces can be calculated from the formula: —

$$r = \sqrt{\frac{V}{\pi N L}}$$

Where r is the radius of the space, V the total volume of all the space, N the number of spaces on a unit area, and L the depth of soil.

The circulation of water through the soil will depend upon the size of these spaces, and not in any simple ratio either, but according to the fourth power of the radius multiplied by the number of spaces. You will bear in mind we are not trying to establish absolute but relative values.

Here are ten tubes, each with a radius of three units, and here is one single tube with a radius of ten units, having the same capacity and area of cross section of the ten tubes. If they were exceedingly small capillary tubes water would flow through the single large tube about twelve times faster than through the ten tubes. So it is in the soil. If we assume that there is the same amount of empty space in a clay soil as in a sandy soil, there are at least ten times the number of spaces in the clay soil for the water to move through, and the movement is very much slower than in a sandy soil. Clay has no inherent property of absorbing and holding moisture not possessed by sand, as popularly supposed, the difference being due entirely to the number of particles per unit mass.

I want now to show you that the size of these spaces upon which the circulation of water depends may be varied at will by the ordinary commercial fertilizers used by farmers. And first let me show you the very simple but curious (for hitherto unexplained) phenomena of flocculation.

Here is some muddy water in this beaker. The particles of clay are so extremely small, and have so much surface in proportion to their weight, that the ordinary convection currents in the liquid are sufficient to keep them in suspension for an indefinite time. A trace of salt, kainit, or acid will cause the clay to come together in light, loose flocks, like curdled milk, and these flocks will quickly settle and leave the water above perfectly clear. If only a trace of these substances has been added, a few drops of ammonia will neutralize this effect, and break up the flocks and push the clay particles without the range of their mutual attraction, so that the liquid will not clear for days or weeks or years.

When this is watched under the microscope, the particles in the turbid liquid when ammonia is present — if they are very small and freely suspended in the liquid — do not ordinarily come very close together, or if they do they are shoved aside by an elastic cushion. When the least excess of acid, salt, or lime is added, however, they not only come close together but segregate in large flocks, which float around as though held by a rigid hand. If too much acid has not been added, the further addition of ammonia will push the particles apart again, but this cannot be kept up indefinitely, for the accumulation of the salt formed causes a permanent flocculation, which we have not yet been able to overcome.

As I have said, the reason for this has not yet been satisfactory explained, although it has formed the substance of several memoirs to the National Academy of Sciences and of a large bulletin of the United States Geological Survey. It is a phenomenon of great economic importance, as it accounts for the formation of flats and shoals at the mouth of rivers where they empty their muddy water into the salt waters of the ocean, for the curious periodic shoaling and deepening of the channel at the mouth of the Mississippi River with low and high water, and for the peculiar clearness of limestone water. It is a phenomenon also of the utmost importance to agriculture.

I am glad to say that Dr. Kimball has taken an interest in it, and has given valuable aid and suggestions, and I believe we shall be able to work it out before long, as we already have a very plausible and tentative explanation awaiting experimental verification.

I will try to show you that similar forces may act in the soil, and produce very material and important modifications in the arrangement of the soil grains — changing in a very remarkable degree the relation of the soil to the circulation of water.

Here are three argand lamp chimneys eight inches long and two inches in diameter, the upper two inches of the tube being graduated on the side. Equal weights of the same soil occupies six inches in depth of each tube. The soil is the characteristic truck land of Anne Arundel County, — light, loose, and loamy; almost too light for wheat or grass, for water circulates too freely in it for these crops. An inch in depth of water passed through these saturated soils in just about the same time (twenty-five minutes): a few drops of a solution of kainit was added to the water in this second tube, and a few drops of ammonia to the water in this third one. The effect of the kainit, as in the muddy liquid, is to pull the fine particles of clay much closer to the grains of sand and to make the soil more loamy and looser in texture. The large spaces have become larger, and the small spaces smaller, and the effect of this, as you saw with the tubes, is to very materially increase the rate with which water circulates in the soil.

Now I do not pretend to say that even under the intense condition of my experiment this change is instantaneous, for it is not. While the acid or salt, or kainit or lime, makes it possible for the soil particles to come closer together, the motive power which actually brings them together is probably the changing temperature and changing moisture content, so that in practice the change in the physical structure of the soils will probably be very gradual, and be noticeable only after several years of continuous application.

Sir John Lawes has observed that the continued use of nitrate of soda has made his soil more loamy and porous. It is a matter of common experience that such changes occur in stiff clay land from the continued use of acid phosphates and lime, but no special significance has ever been attached to it, as it has been considered incidental to other benefits (hitherto unexplained, be it understood) derived from the application.

The effect of ammonia on the soil is even more remarkable, as it is so instantaneous, and the effect even in this short time is so marked. The ammonia loosens the hold of the clay particles on the grains of sand, and the currents of water in the narrow spaces seemingly are sufficient to detach them, as the liquid, before clear, is now muddy. The further movements can be watched under a microscope focused against the side of the tube. The clay flocculates immediately, probably from the effect of the salts in the soil, and these loose flocks, floating around, catch against the projecting sides of the grains of sand, and the spaces gradually fill up with this light, loose material.

The clay is more evenly distributed throughout the soil, and the circulation of water is very much retarded. While before the ammonia was put in, the inch of water passed through the soil in about twenty-five minutes, it will take it now at least six or eight hours.

From our own work it is probable that the organic matter of stable manure and the alkaline carbonate of wood ashes would have much this same effect, and I believe this is the reason the agricultural value of these substances on certain soils has always been out of all proportion to the amount of plant food they contain.

This interpretation of the results of the mechanical analysis of soils gives a very clear explanation of the marked adaptability of certain plants for certain characters of soils under the same climatic conditions. Truck, wheat, grass, and the different grades of tobacco all succeed best on soils which differ essentially in their physical properties. Not only so, but it is quite possible to calculate the relative rate with which water will circulate through these different types, and we have, therefore, a means of classifying soils by referring them to these types; and when the observed rate of circulation differs from the rate calculated from the mechanical analysis, as it does in "worn out" lands, we have the still more important information of the changes which have occurred in the structure of the soil, and we have seen that this may be varied at will by the ordinary fertilizing materials. I am satisfied that it is through some such careful study of the soil further advance in agriculture will be made and the most intelligent use of manures and fertilizers be secured.

THE MARYLAND WEATHER SERVICE.

THE organization of State weather services to conduct observations over limited areas has been undertaken in recent years in many portions of the country. What the national service does for the entire United States, the local service does for each State. While the United States Signal Service affords information concerning the general climatic conditions prevailing over the whole country, the State service shows what those conditions are in the various districts and counties of the State. It at once becomes an important medium to the agriculturist, through which he learns the most favorable times to plant or reap, and how best to protect his crops. It aids the shipping interests along the coasts and in the bays and rivers, by indicating the character of the weather and the direction of the winds. It gives to all the valuable predictions of the national service, together with the conditions that locally prevail. The local service has been officially recognized by many of the States already as of the greatest commercial importance, and provision has been made for its maintenance. In others the chief expense has been borne by the United States Signal Service, and a sufficient number of men detailed to efficiently conduct the work.

The Maryland State weather service has been organized under the joint auspices of the Johns Hopkins University, the Maryland Agricultural College, and the United States Signal Service. The officers are: William B. Clark, Johns Hopkins University, director; Milton Whitney, Maryland Agricultural College, secretary and treasurer; C. P. Cronk, United States Signal Service, meteorologist in charge. The United States Signal Service will furnish men to take charge of the details of the work, will supply instruments to the observers in the various portions of the State, and will afford the means of sending out weather predictions and general summaries of temperature and rainfall. The ten stations in Maryland that now report directly to Washington will become incorporated in the State service, and the number of stations will be increased to forty or more, to meet the requirements of an efficient service.

It is proposed to print monthly a general report of meteorological conditions, and weekly to send throughout the State a brief statement as to the crop prospects. A scheme will be devised by which frost warnings may also be given. An important feature of the work will be the establishment of signal stations at such points on the Chesapeake Bay and its tributaries as can be readily communicated with, so that the captains of vessels can gain information as to the probable direction of the winds. As the efficiency of the State service will depend largely upon the closeness of co-operation with the United States Signal Service, it has been considered advisable to move the Baltimore office of the latter to the university, and it will after May 20 have quarters in the physical laboratory, upon the roof of which building the observations will be taken. An office will be retained in the centre of the business portion of the city so as to be in close communication with the public as heretofore. It is anticipated that the work outlined above will be fully inaugurated during the present summer.

COAL IN THE SHAN STATES.

A REPORT from Dr. Noetling, the geological expert who has been dispatched from India to investigate the coal measures of the region between the Irrawaddy and the Salween, has recently been issued in Burmah, and an abstract of it has appeared in the London *Times*. The result of the analyses of twelve samples of coal show a remarkable uniformity of composition. The highest percentage of fixed carbon is 38 58, and the lowest 31.69. If the average of eleven analyses is taken, it is found that Shan coal has the following composition: Volatile matter (including moisture), 55.40; fixed carbon, 34.94; ash, 9.67. The coal is, therefore, of poor quality, and can hardly be termed "coal." "Lignite," or "brown coal," would better express its composition. Shan coal, when fresh, would make good fuel, and, being rather hard, it will stand long transport Those seams from which, owing to its friability, the coal could not be well transported, should make an excellent material for patent fuel. It is much poorer than the coal of the southern Shan States. In the latter the percentage of fixed carbon is from 64 to 70. So far, however, as is known, coal is not very plentiful in the southern Shan States, while the seams in the northern States are more favorably deposited, and, being found in workable quantities, they could be depended on for the supply of fuel to any railway through the Shan States. The fields examined by Dr. Noetling in the northern Shan States were seven in number, the two chief ones being Laisho and Namma Manze. He does not think they will be of any value so long as there is no communication by which the coal can be easily brought down to the Irrawaddy. The coal-fields are about one hundred and seventy miles away from the nearest centre of traffic. The present road leading to them is only suited for carts for about fifty miles, after which pack animals must be employed. It is absolutely essential that a railway should be constructed if the coal fields of the northern Shan States are to be of any economical value. But the construction of a railway line to this part of the country would be a costly undertaking if the fuel necessary to work it had to be transported from Rangoon. Moreover, the alluvial deposits in both the principal coal-fields would form a serious obstacle to mining operations. The thick layer of clay in the Laisho field and the conglomerate in the Namma field would make the sinking of a shaft difficult, as it would have to be constructed very substantially in order to resist the lateral pressure which it would have to stand in the alluvial deposits. Owing to the peculiar way in which the coal-bearing strata are found, a large quantity of water must be expected in both coal-fields, and this would require strong pumping machinery. Finally, the climate of these valleys is feverish, and the health of the miners would therefore be severely tried. It thus appears that coal-mining in the northern Shan States is in the distant future; every thing seems to be unfavorable to its development, — no transport, difficulties of working, quantities of water, unhealthy districts, doubtful seams, and bad coal.

SCIENTIFIC EXPEDITION TO SOUTH MARYLAND.

A REPORT of the recent scientific expedition into southern Maryland appears in the Johns Hopkins University circular for June. The need of a more complete knowledge of the material resources of the southern portion of the State of Maryland led to the organization of this expedition to further its investigation. The expedition, under the joint auspices of the Johns Hopkins University, the Maryland Agricultural College, and the United States Geological Survey, had in view the study, from different standpoints, of the varied capabilities of this section. The importance for this work of co-operation between the State and national scientific institutions was recognized from the start, and it is determined that the plan for joint investigation, thus inaugurated by a preliminary and general survey, shall in the near future embrace, under similar auspices, a detailed examination of the geology, agriculture, and archæology of all of southern Maryland. A wrong impression would, however, be conveyed, if the idea should be gained that nothing has been accomplished hitherto in this direction. Several of the members of the expedition have been actively employed in the past in making investigations in various portions of the region, among whom Mr. Darton deserves especial mention, while Mr. Clark has conducted thither three annual geological excursions, so that the knowledge gained in previous years has afforded a basis for work at the present time. The expedition received from the start the cordial support of all those interested in the material progress of southern Maryland. The necessary means of transportation were furnished by the State upon the authorization of the Board of Public Works and of Gen. Joseph B. Seth, commander of the Oyster Police Navy. The steamer "Gov. P. F. Thomas," Capt. Howard, and the schooners "Daisy Archer" and "Folly" were placed at the disposal of the expedition, and their officers and crews rendered most efficient service. The heads of the several institutions interested appointed the following representatives, who organized as a Board of Control: William B. Clark, Johns Hopkins University, chairman; Milton Whitney, Maryland Agricultural College, secretary and treasurer; W. J. McGee, United States Geological Survey. The other members of the expedition included Professor George H.

Williams, Messrs. A. E. Bibbins, F. P. King, E. P. Kohler, P. R. Moale, R. M. Parks, Jun., D. H. Roberts, M. J. Vea, and D. B. Pope, of the Johns Hopkins University; President Henry E. Alvord of the Maryland Agricultural College; Messrs. W. H. Holmes, N. H. Darton, C. D. White, and G. D. Harris, of the United States Geological Survey; Dr. E. Lewis Sturtevant, late director of the New Yerk Agricultural Experiment Station; Professor Frank D. Adams of McGill College, Montreal; and Mr. G. L. Collie of Harvard University; while President D. C. Gilman and Dr. H. M. Hurd, as guests of the expedition, accompanied the party the first day as far as Annapolis The expedition started from Baltimore at noon of April 23, and reached Washington, where the party was disbanded, at noon of April 30. Four lines of investigation were proposed, namely: (1) study of the oyster; (2) study of the geological formations; (3) study of the soils; (4) study of the Indian remains. By reason of the illness of Mr. A. E. Bibbins, which necessitated his return to Baltimore, work upon the oyster, of which he had charge, had unfortunately to be abandoned, although indications of good results were shown during the day or two he was with the party. The geological work, under the direction of Mr. Clark, assisted by Mr. N. H. Darton, was participated in by the larger number present; the agricultural investigations were conducted by Professor Milton Whitney; and Professor W. H. Holmes of the Smithsonian Institution examined the area for evidence of Indian occupation.

LETTERS TO THE EDITOR.

**** Correspondents are requested to be as brief as possible. The writer's name is in all cases required as proof of good faith.*

On request, twenty copies of the number containing his communication will be furnished free to any correspondent.

Eddies in the Atmosphere.

DURING last December there was published a paper by Professor Bezold "On the Theory of Cyclones" (*Sitzungsberichte der königlich preussischen Academy der Wissenschaften zu Berlin*). This exhaustive setting forth of theories by the director of the German meteorological bureau is of the highest interest, and demands notice from this side of the ocean. Professor Bezold says: "If one has attentively followed meteorologic literature for late years, so can he not fail to note that in the fundamental principles of air motions, little by little, a powerful revolution has taken place." Our author then gives a summary of the views that have arisen from time to time, especially regarding the relations between the general atmospheric circulation between the equator and poles, and the occurrence of storms or eddies in this circulation. He then gives a theoretic discussion of a particular cyclonic circulation, stationary, and having the wind directions parallel to the isobars. In this he finds that the whirl which occurs at the earth's surface extends only a short distance vertically, though he does not intimate whether this height should be 2,000, 10,000, or 20,000 feet. He also finds that if this whirl is exceedingly rapid, as one approaches the axis, a centrifugal effect is induced, and there results an "air-thinning" at the centre; moreover, there would be no tendency for air to rush to the centre, and hence there would be no uprush of air there. This is certainly a most startling conclusion, and agrees almost word for word with the view already advanced in this country ("The Tornado," pp. 57, 58, and others). Our author would account for the condensation and precipitation at the centre from the partial vacuum produced there by centrifugal action.

The origin of the tornado funnel is sought in the upper air current because there there is less friction, but no idea is given of even the approximate height of this formation. If the velocity of the gyration becomes sufficiently great, and other conditions favor, the funnel may reach the earth. This conclusion is also drawn: "In wide extended cyclones is it somewhat different; here is it very well thinkable, that, through the origin, or especially through the stronger unfolding of the same, in the middle atmospheric layers, which arise as well through the general circulation, as also in consequence of local drawing-in of the air, even as well is the air sucked into this whirl or eddy in the middle atmosphere, from above as from below." This is a most extraordinary result of this study. It is a little to be regretted that no idea whatever is given of the approximate height of this middle region, whether 5,000 or 10,000 feet. Our author finally concludes that there may be a reconciliation between the anomalous results of temperature conditions in storms and high areas, as found by Dr. Hann, and his own studies here given, as well as between the older convection theory and the eddy theory of M. Faye, more recently adopted by Siemens and Hann.

Professor Bezold's whole paper, of twenty-three royal-octavo pages, is very interesting reading, and should be perused by every one interested in the subject. It seems as though, in his attempts to reconcile two theories which are diametrically opposed to each other in almost every particular, he has indulged in some remarkable flights of imagination, but that question I leave for discussion to the advocates of each theory. Faye's view, that our storms are eddies in the upper atmosphere, seems to be gaining ground, and has already been accepted by Siemens and Hann. In *Science* for March 13, p. 151, I have suggested that "these views are entirely at variance with the facts observed in this country, and cannot possibly be accepted as an explanation of the phenomena in question." I desire to advance a few facts which show how untenable such an hypothesis as this eddy theory is.

1. The direction of the upper current does not coincide with that of the storm, but is very often at right angles to it.

2. The velocity of each stratum increases as we rise in the atmosphere to about 15,000 feet or a little less, and then diminishes; and in only a very limited stratum, perhaps at about 5,000 feet or less, is it the same as that of the storm. It is easy to see that no eddy could possibly be maintained more than a few minutes under such conditions.

3. The existence of the high area is practically ignored in this theory, though it must be very evident to every student of meteorology in this country that the high area is almost as important as the storm, and is built up under somewhat similar conditions, though with an opposite sign. To be sure M. Faye regards the high area as a static phenomenon, being led thereto by the stationary character exhibited by it in Europe, but in this country it is almost as much a dynamic phenomenon as the storm itself.

4. There are no obstructions, or counter currents at the same level, which can be invoked in calling such eddies into existence.

5. Even if it be granted that such an eddy can originate in the upper atmosphere, it is plain that its gyrations could not be transmitted to the earth through a frictionless medium. It has been computed that about twenty years would be needed for the communication of such conditions, through friction, in an air thickness of only three hundred feet.

6. If such an eddy should begin in the upper atmosphere, it is perfectly certain that absolutely no precipitation could result from it, for its downward propulsion, if it could occur, would serve to thoroughly dry the air.

7. High-level observations in this country show that a good share of the variation in pressure in our high areas and storms is far above the highest mountains, and very far from where any appreciable eddy could be formed.

8. There is absolutely no whirl in the air above 4,000 feet or less. This is fatal to this eddy hypothesis.

In *Science* for June 5 is an abstract or short statement of a paper, by Rev. W. H. Dines, read before the Royal Meteorological Society, in which were discussed these theories of storms: (1) The convection theory, or Espy's; (2) the eddy theory, or Faye's. To these I wish to add two more: (3) the wave theory, first proposed by Archibald, so far as I know, in these words: "Many facts, such as the observed direction of the upper clouds over and surrounding a cyclone, the velocities at the surface in different quadrants, the retardation of the barometric minima at mountain stations, and the frequently small elevation reached by the entire disturbance (not more than 6,500 feet, according to Loomis), tally more with a species of wave-motion by which the conditions are continually reproduced in a certain direction, than with the drift theory, and in any case require other and additional causes for their complete elucidation" (*Nature*, June 14, 1888, p. 151). This same theory has been independently advanced by Mr. John Eliot of India (*Science*, May 29, 1891). This theory is undoubtedly a great advance on the others, but is not entirely satisfactory. It

is much to be hoped that when fully carried out it will not only annihilate the others but will lead up to the true theory. (4) The electric field theory.

The final theory must include the following points: (*a*) Storms and high areas are largely dependent upon each other, and are somewhat alike except with opposite signs.

(*b*) The velocity of the current varies at every level as one rises in the atmosphere.

(*c*) In this country at least, storms and high areas follow each other and have practically the same velocity.

(*d* The conditions producing our storms and high areas seem to extend far above our highest mountains, and may extend to the limits of the atmosphere.

(*e*) There is no motion or carrying of air or moisture particles in a horizontal or up-and-down direction, by pure air currents, to form storms or high areas.

(*f*) There is an enormous increase of moisture in the fore-front of storms, entirely independent of precipitation, wind, heat, evaporation, and every other ordinary element.

(*g*) There is a corresponding dryness in the fore-front of our high areas, which may be due in part to the descent by gravity of the cooler, denser, and drier air above.

(*h*) The precipitation, in the case of general storms, is, in this country at least, far (at times four hundred miles) in advance of the central point of the isobars, and very often none at all falls at the centre.

(*i*) In what may be called normal storms, the velocity may rise to forty or even more miles per hour, especially in the winter season.

(*k*) The temperature in normal storms most emphatically shows no reversal as we ascend in the atmosphere, but, if any thing, shows a greater relative rise at the upper station than occurs at the earth's surface.

(*l*) The temperature in normal high areas has, if any thing, a greater relative diminution at a high mountain station than at the earth's surface.

While the last two propositions are most abundantly borne out on Mount Washington, it should be noted that a study of the conditions at the highest regular station in Europe (Sonnblick, 10,000 feet) has shown no reversal. While there is a difference in the results at the two mountains, yet this is only in degree. Excepting a few anomalous cases, the conditions are practically the same at both stations (*Science*, Sept. 5, 1890).

The time for formulating a consistent theory of storm generation and motion is still a long way off. It seems to me that the most promising sign of recent discussions is the marked tendency on all hands to lay aside pure theoretic considerations and to demand rather the facts and causes which underlie all atmospheric disturbances.

H. A. HAZEN.

Washington, D.C., June 15.

BOOK-REVIEWS.

An Introduction to the Study of Metallurgy. By W. C. ROBERTS-AUSTEN. Philadelphia, Lippincott (London, Griffin). 292 p. 8°.

IN telling something about this book we cannot begin better than by quoting the first part of the preface, which runs as follows: "The literature of metallurgy is rich, but those who are beginning to study it need guidance to a knowledge of the principles on which the art is rightly practised. It depends, as is well known, on the application of chemistry, physics, and mechanics; but the methods of metallurgists vary greatly from those of chemists, who, however, frequently fail to appreciate the difference. Ten years' experience has convinced me that it is more important at the outset for the student to know what was the scope of mind of the early practisers of metallurgy, and to see what kind of aid the art may be expected to receive in future from the sciences, than to acquire familiarity with complicated details of processes and appliances."

In these few sentences the author has given not only the reason for the existence of his book but also an outline of what the student may expect to find in its pages. The first four chapters may be considered almost as a separate section, covering the subject generally as a whole, the other chapters going more into the details of the various processes employed in metallurgy.

The first chapter is devoted wholly to a consideration of the relation of metallurgy to chemistry. The second treats of the physical properties of metals,— molecular structure, density, fracture, malleability, ductility, tenacity, etc. The third chapter is the best brief treatise of the kind and for the purpose we know of in the literature of metallurgy, and might have been expanded into a separate volume without a suspicion of a resort to what is known as "padding." In its thirty-six pages the subject of alloys is presented, briefly, of necessity, but comprehensively and clearly; and the results of recent investigations and experiments are given, including those in which electricity plays a part. The fourth chapter deals with the thermal treatment of metals.

The remaining chapters are devoted respectively to fuel, materials and products of metallurgical processes, means of supplying air to furnaces, typical metallurgical processes, and economic considerations. The illustrations are as numerous as the purpose of the volume warrants; there is an abundance of diagrams and tables, and the table of contents and index are models of their kind.

AMONG THE PUBLISHERS.

THE first number of Vol. II. of the *Outing Weekly Tennis Record* for the season of 1891, was published on June 13. It is the official organ and bulletin of the United States National Lawn Tennis Association.

— G. P. Putnam's Son's have just ready a handsome volume entitled "Landscape Gardening," by Samuel Parsons, Jun., containing notes and suggestions on lawns and lawn planting, laying out and arrangement of country places, large and small parks, trees, shrubs, plants, rockwork, etc. They have also ready an American edition of Professor William Peck's "Popular Handbook and Atlas of Astronomy."

— J. G. Cupples of Boston will publish immediately "The Life-Romance of an Algebraist," by George Winslow Pierce, a distinguished pupil of the late Benjamin Peirce, the eminent professor of mathematics in Harvard University. This book opens with a discovery in algebra, addressed to students, and proceeds with the discussion of every subject of human interest, poetry, philosophy, constructive criticism, adventure, forms of truth, and mysteries of being, strung on the thread of a love story.

— The July number of *The Annals* of the American Academy of Policical and Social Science will contain a translation into English of the Constitution of Mexico, by Professor Bernard Moses of the University of California. Dr. G. Ritchie, instructor in Oxford University, has contributed to the same number an article on the teaching of political science in that institution. Professor J. W. Jenks of the University of Indiana discusses a reform of the system of land transfer, and advocates the adoption of a method which shall guarantee security to the purchaser, without the heavy expense and uncertainty which the existing system involves. "The Economic Basis of Prohibition," a paper read by Professor Simon N. Patten of the University of Pennsylvania at the May meeting of the American Academy of Political and Social Science, also appears in the same issue.

— Among its new and continued articles the *American Journal of Archæology* for the present year will contain the following: "A Series of Babylonian and Assyrian dated Cylinders," by Mr. T. G. Pinches of the British Museum; "Hittite Sculptures," and "Oriental Antiquities," by Dr. William Hayes Ward of New York; "Antiquities of Phrygia," by Professor William M. Ramsay of Aberdeen, Scotland; "Terracottas in American Collections," by Salomon Reinach of the Museum of Saint-Germain, France; "The Aphrodite of Melos," by Dr. A. Furtwangler of Berlin; "Three Heads of Zeus, Hades, and Poseidon, of the Hellenistic Period," by Professor Adolph Michaelis of Strassburg; "A New Fragment of the Edict of Diocletian, found at Plataia in 1890," by Professor Theodor Mommsen of Berlin; "The Mantineian Reliefs," by Dr. Charles Waldstein, director of the American School at Athens; "Terracottas from Southern Italy, now in Baltimore," by Professor Har-

old N. Fowler of Exeter and Professor James R. Wheeler of Burlington; "A Bronze Statue of the Emperor Geta." by Professor Harold N. Fowler of Exeter; "On Some Coptic Illuminated Manuscripts." by Professor Tikkanen of Helsingfors, Russia; "Norms in Greek Architecture," by Professor Allan Marquand of Princeton; "The Early Christian Palace recently discovered under the Church of SS. Giovanni e Paolo, at Rome," by Padre Germano, of the Order of Passionists, Rome; "Cistercian Monuments as the Earliest Gothic Constructions in Italy," "Roman Artists of the Middle Ages," "Christian Mosaics," "Tombs of the Popes at Viterbo," and "Early-Christian and Mediæval Monuments in Italy," by Professor A. L. Frothingham, Jun., of Princeton. This journal is the organ of the Archæological Institute of America, and the medium of direct communication from the American School at Athens.

— A second edition of "A Treatise on Massage, Theoretical and Practical." by Douglas Graham, M.D., has been published by J. H. Vail & Co. of this city. In the five or six years since the appearance of the first edition of the work, the literature of the subject has increased materially, and massage may be said to have settled into its proper place in medicine. The volume before us covers fully its history, mode of application, and effects, together with indications and contra-indications; besides giving the results in over fifteen hundred cases. The work has been thoroughly revised and considerably enlarged. There are numerous additions confirmatory of statements previously regarded as doubtful, and interesting items, long lost sight of in old literature, about the successful employment of massage, have been given a place in the chapters devoted to the history of the subject. Two new chapters have been added, one on local massage for local neurasthenia, the other on the treatment of scoliosis by means of massage. In addition there is much new information, mainly from European sources, on the uses of massage in affections of the ear, in scoliosis, in fractures near and into joints, and in affections of the abdominal organs. No illustrations are given in the volume, as the author believes that "even instantaneous photography can give but a poor conception of motion, which can be done much better by words." The principles of massage are so clearly set forth by the author, however, that they may be easily understood and made available by any one who has sufficient knowledge of anatomy, and acquaintance with the natural and morbid consistency of tissues. With this knowledge, as the author observes, "pictures are unnecessary; without it, they would be useless."

— Ginn & Co. announce to be published this month "The Modalist, or the Laws of Rational Conviction," a text-book in formal or general logic, by Edward John Hamilton, D.D., Albert Barnes professor of intellectual philosophy in Hamilton College, N.Y. This book, which the publishers believe a noteworthy one, is called "The Modalist" because it restores modal propositions and modal syllogisms to the place of importance which they occu-

Publications received at Editor's Office, June 3–16.

BAUMEISTER, R. The Cleaning and Sewerage of Cities. (Tr. and adapted by J. M. Goodell.) New York, Engineering News Publ. Co. 281 p. 8°. $2.50.

CARUS, P. Fundamental Problems. 2d ed. Chicago, Open Court Publ. Co. 373 p. 8°. $1.50.

CHIEF Signal Officer of the Army, Annual Report of, for the Year 1890. Washington, Government. 713 p. 8°.

MISSOURI Botanical Garden, Second Annual Report. St. Louis, State. 117 p. 48 pl. 8°.

PARKER, T. J. Lessons in Elementary Biology. New York, Macmillan. 408 p. 12°. $2.25.

PENNSYLVANIA State College, Annual Report of the, for the Year 1889. Harrisburg, State. 282 p. 8°.

PRIEM, F. L'Evolution des Formes Animales avant l'apparition de L'Homme. Paris, Baillière. 384 p. 12°.

THOMSON, Sir W. Popular Lectures and Addresses. Vol. III., Navigation. (Nature Series.) New York, Macmillan. 511 p. 12°. $2.

WHITING, H. Experiments in Physical Measurement. Part III. Cambridge, Wilson. (Univ. Pr.) 900 p. 8°.

pied in the logic of Aristotle. Professor Hamilton thinks that universal and particular categorical propositions cannot be understood, as principles of reasoning and as employed in "mediate inference," unless the one be regarded as expressing a necessary and the other a contingent sequence. Therefore also he explains the pure syllogism by the modal. Moreover, there are modes of reasoning which can be formulated only in modal syllogisms. Logic is the science, not of thought simply as such, but of thought as the instrument of rational conviction, and therefore of thought in its relation to metaphysics, which is the science of the nature and laws of things. Some radical modifications of logical doctrine have resulted from the thorough-going application of this principle, and these, it is believed, have added greatly to the intelligibility of the science.

— Charles Scribner's Sons have in Press "Taxidermy and Zoölogical Collecting," a new book by William T. Hornaday, for eight years chief taxidermist in the United States National Museum. It will be copiously illustrated. The book is written in a popular rather than a technical style, and yet when necessary the details of the art of preserving birds, animals, etc., are described with the utmost precision.

— With the issue of June 6, Geo. M. Gould, M.D., assumed editorial charge of *The Medical News* of Philadelphia. In "An Introductory Word," the new editor says: "Our aim will be to serve as the intermediary for bringing to the busy practical worker the useful results of original medical research, and the concrete lessons of many single rich experiences. A brilliant and striking illustration of such an ideal as we have described very appositely occurs in the present issue of *The News:* When, from the examination of a drop of blood taken from a patient's finger, hitherto unsuspected disease may be diagnosticated, and either a heroic treatment that saves life instituted, or a speedily realized fatal prognosis announced, our faith in our science at once rises, and our power over disease is vastly increased."